WEWZO03 1149

ECRIS 2020

High Intense Vanadium-Ion Beam Production to Search for New Super-Heavy Element (SHE) With Z = 119

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Introduction (1)

"Synthesis super heavy element (SHE) with Z =119" was started since 2016

$$_{23}\mathrm{V} + {}_{96}\mathrm{Cm} \rightarrow {}_{119}\mathrm{SHE}$$

Introduction (2)

Requirements

1) **Higher acceleration energy** than before
2) **High Intensity** vanadium-ion (V-ion) beam
3) **About 1-month stable beam supply** without interruption

1) → SRILAC with 10-superconducting (SC) cavities

An emerging issue in SRILAC operation is

Particulate matters (PM) produced by sputtering (beam loss).

PM adsorbed on the surface of cavity

→ **Serious reduction** of **the accelerate voltage**

→ **Emittance Limitation** using **"Slit Triplet" of LEBT**

→ **The intensity** was **reduced to ~30 %** of that of analyzed beam.

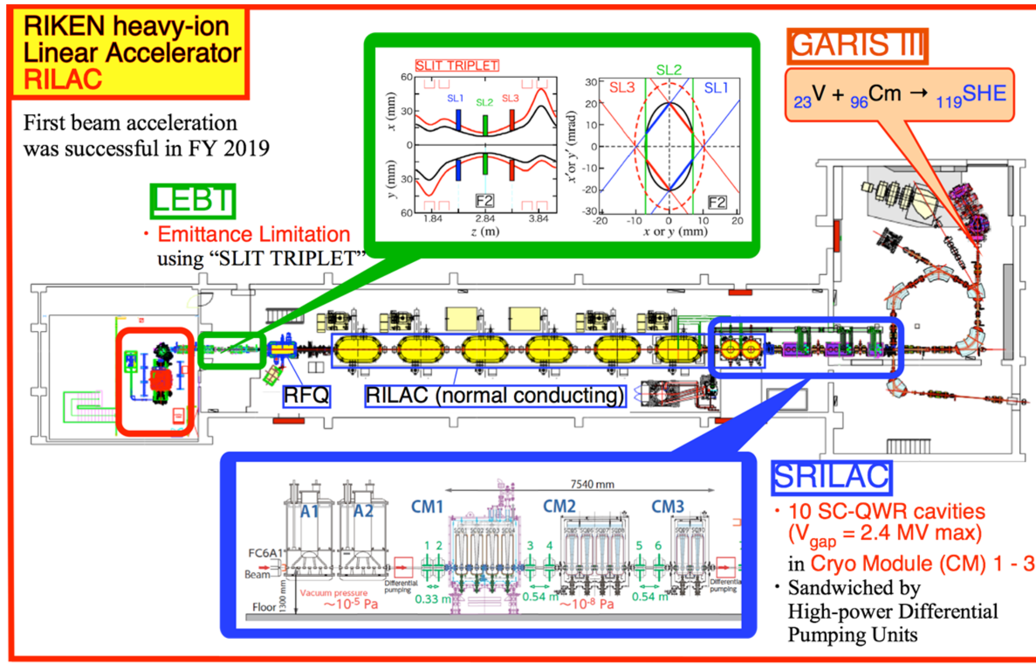


Figure 1: Upgraded RILAC for the new SHE project.

To meet the requests 2) and 3)

a) Investigate Optimum Parameters, the V-vapor amount and the microwave power

b) Develop Large-capacity High Temperature Oven system (HTO).

Experimental(1)

a) Optimization of the V-ion-beam intensity

- **Total microwave power** (18 and 28GHz)
- **V-vapor amount**

V^{13+}-beam intensity

- **V-ion-beam Intensity** ← Faraday cup
- **Total microwave power**
  ← Temperature raise + Flow rate of Cooling water
- **The V-vapor amount** is equivalent to the **V-sample consumption rate**.

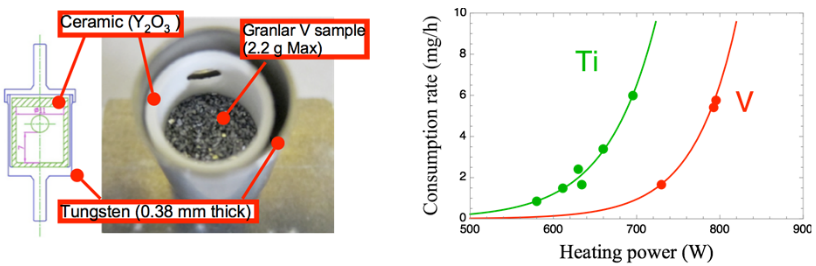


Figure 3: HTO Crucible and the V-consumption rate

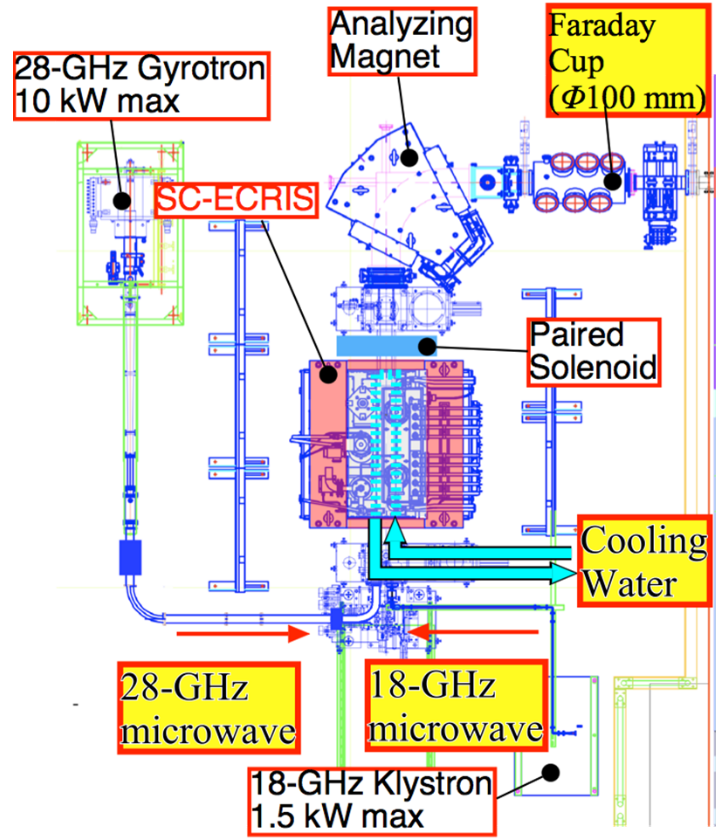


Figure 2: Experimental Setup

Experimental(2)

b) Large capacity High Temperature Oven (HTO)

- A crucible is heated by the Joule heating (DC current).
- **Two Crucibles** were equipped as shown in Fig. 3.
  → **4.4 g** of granular V sample is available.

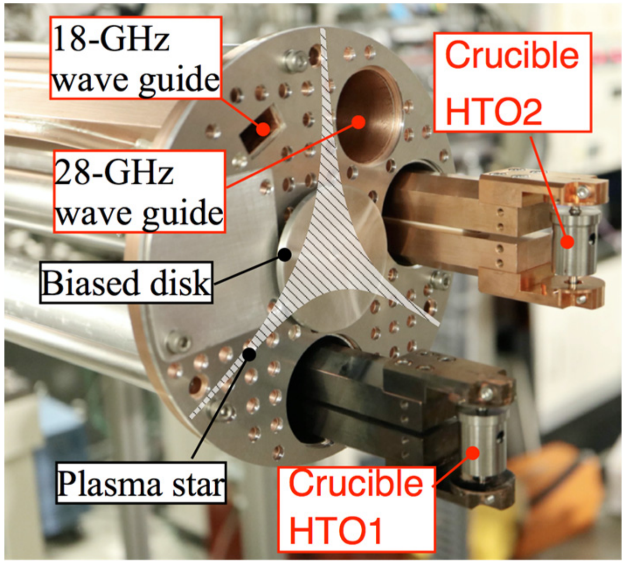


Figure 4: Double HTO system

Result (1) "Individually" using HTO 1 and 2,

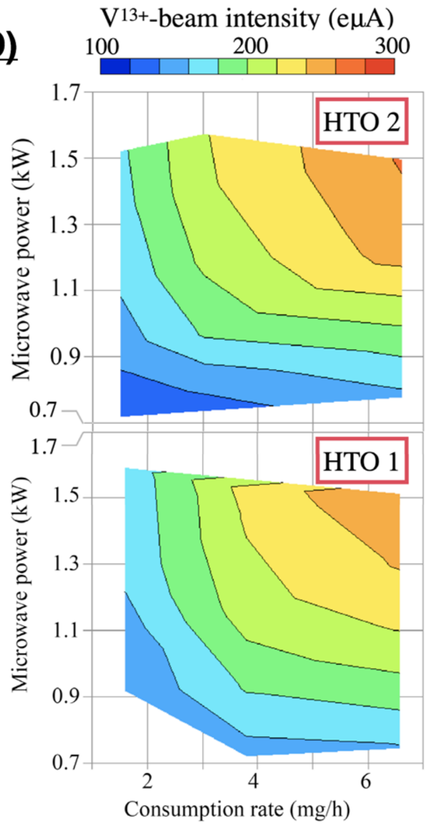
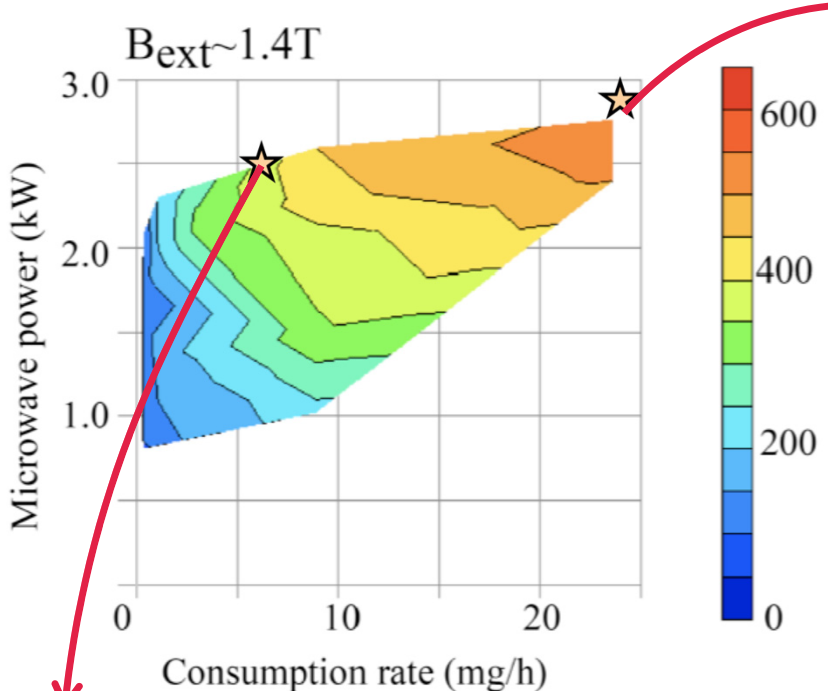


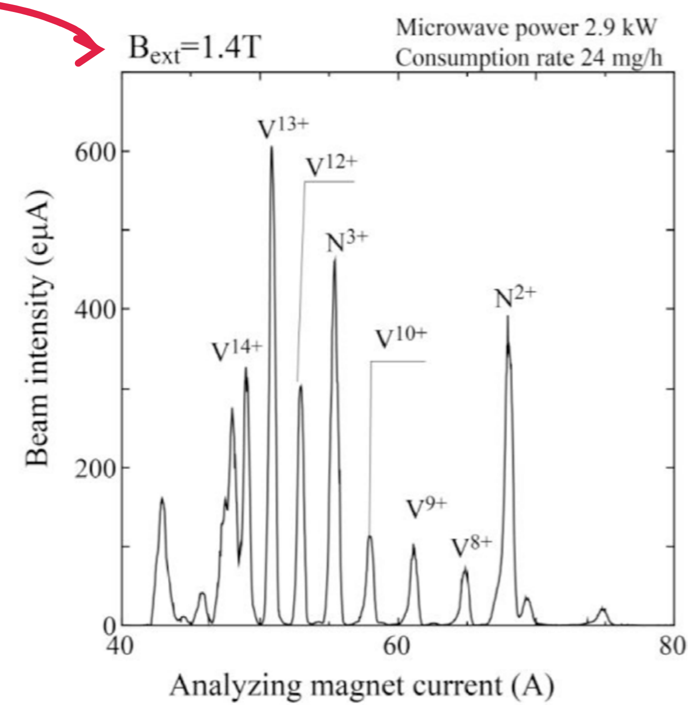
Figure 5: Obtained V^{13+}-beam intensity "individually" using HTO 1 and 2

-The intensity clearly depends on the consumption rate and the microwave power as shown as the 2-D contour plots

-No significant difference between the different HTO positions using the Faraday cup only.

Result (2) "Simultaneously" using HTO 1 and 2





400 eμA with ~ 6 mg/h and 2.5 kW

Approximately 1 month beam supply for Synth. Exp.

Figure 6: Obtained V^{13+}-beam intensity "simultaneously" using HTO 1 and 2

600 eμA with ~ 24 mg/h and 2.9 kW

Approximately 1 week beam supply for Dev.

Figure 7: M/Q spectrum as a function of current of the analyzing magnet

Result (3)

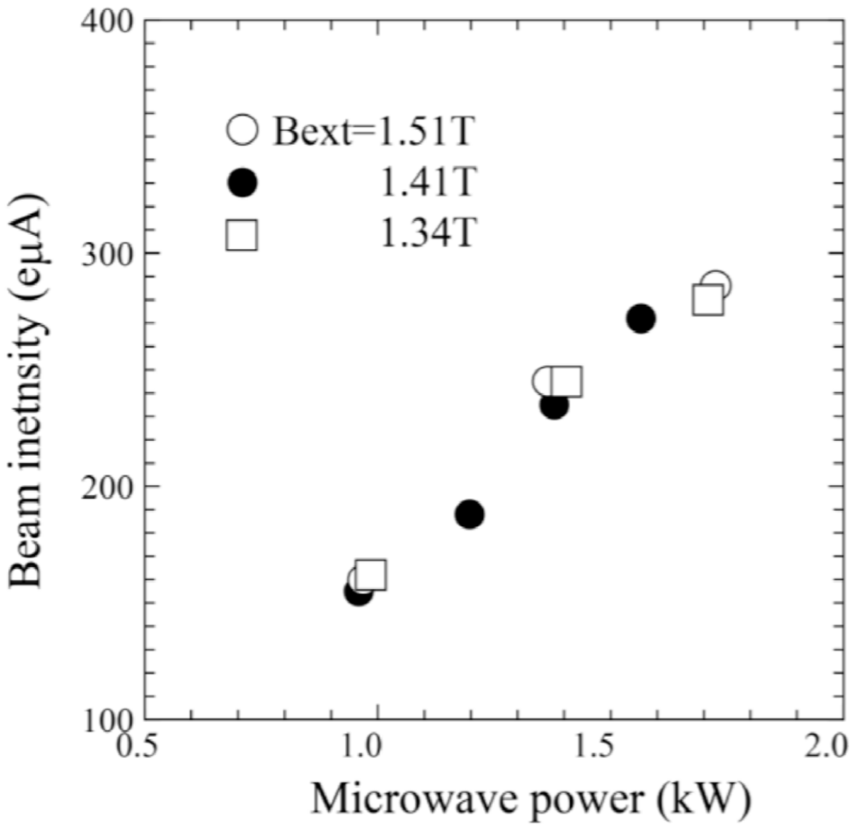


Figure 7: The V^{13+}-ion beam intensity obtained as a function of the microwave power when the the B_{ext} is changed from 1.34 to 1.51 T.

-No significant difference between the changes in B_{ext} from 1.34 to 1.51 T.

Conclusions

1) We measured **the V^{13+}-beam intensity** as a function of both **the V-consumption rate** and **the microwave power**.

- *The optimized beam intensity was plotted as the two-dimensional contour plot.*

- *Simultaneously using two HTO crucibles allows us to execute SHE synthesis*

- *The V^{13+}-beam intensity of 400 eμA at a consumption rate of ~ 6 mg/h and a microwave power of 2.5 kW.*
→ The high-intensity beam lasts ~ 1 month without interruption for SHE synthesis.

- *The V^{13+}-beam intensity of 600 eμA at a consumption rate of 24 mg/h and a microwave power of 2.9 kW.*
→The extra-high-intensity beam lasts for ~1 week, for the essential development.

2) **No significant effects by changing the oven position and varying B_{ext} between 1.34 and 1.51 T** on the beam intensity were observed within the scope of the simple measurement using only a Faraday cup.